Health Impacts of Fine Particle Components in California

April 26, 2007

Air Resources Board

California Environmental Protection Agency

Thank you Ms. Witherspoon. Good morning Dr. Sawyer and members of the Board.

In this health update, I will discuss the results from a recent study evaluating the association between the components of fine particulate matter air pollution and premature deaths in six California counties.

The Board has heard before of the association between fine PM and adverse health effects, such as asthma symptoms, hospitalizations and premature deaths. Determining which components of PM are responsible for adverse health effects is an active area of research, and this study represents one step on that path.

Background

- 8,200 deaths per year in California associated with exposure to fine PM (PM 2.5)
- Long-term and short-term exposure to fine PM associated with premature death and illness
- Are some particles more toxic than others?
- Which components of fine PM are associated with mortality?

The effect particulates have on premature deaths is especially important in California because we estimate that 8,200 premature deaths in Californian each year can be associated with exposure to fine PM.

Both long-term and short-term health studies show an increased risk of dying associated with exposure to fine PM. Long-term studies like the American Cancer Society Cohort followed approximately 500,000 adults for 20 years and examined the effect of PM on premature death. They reported a statistically significant increase in mortality due to long-term exposure to PM.

The study presented to you today evaluates short-term impacts of exposure to fine PM. It investigated the daily fluctuations in fine PM and its components and their influence on daily deaths in six California counties.

People are exposed to a complex mixture of PM from many sources. This type of study has the advantage of helping to relate PM components to sources. It helps us answer the question: Are some particles more toxic than others? And which components of PM are most responsible for the associated premature deaths?

Study Description

- PM mass and components: 2000 to 2003
- Cause of Death: all-causes, heart and lung disease, and all-cause for greater than 65 years old.
- Fresno, Kern, Riverside, Sacramento, San Diego, Santa Clara
  - 8.7 Million people, 25% of California's population
- Health effects measured up to 3 days after pollution episode

Ostro B, Feng W-Y, Broadwin R, Green S, Lipsett M. The Effects of Fine Particle Species on Daily Mortality and Morbidity in Six California Counties: Results from CALFINE. EHP, V115(1) 2007.

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Today's presentation highlights a recent publication by Dr. Bart Ostro and colleagues from the Office of Environmental Health Hazard Assessment. Dr. Ostro is scheduled to present in these results in detail in a Chairman's Seminar later this year.

In order to study the relative toxicity of components of PM, the researchers collected data on the ambient concentration of fine PM and the daily number of deaths from 2000 to 2003.

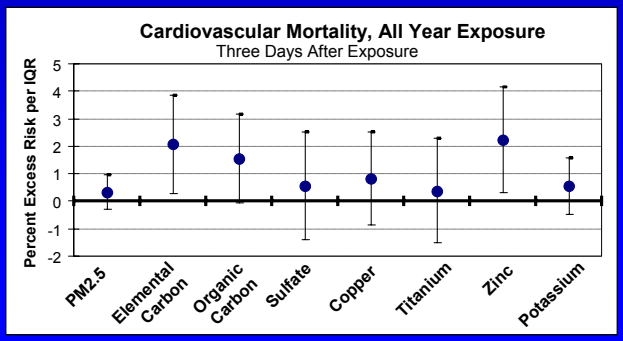
Daily deaths from all causes, heart and lung disease, and deaths in persons greater than 65 years old were matched to fine PM. Deaths from accidents were not included in the data. In this presentation, I will highlight the link between fine PM components and deaths from heart disease.

Fine PM samples were collected on filters, and analyzed for elemental carbon, organic carbon, nitrate, sulfate, and various metals. They were collected from six California counties: Fresno, Kern, Riverside, Sacramento, San Diego and Santa Clara counties which represent 8.7 million people and 25% of California's population.

People are not necessarily affected by PM on the day of a high air pollution episode. There may be a lag in time between exposure to high PM and adverse health effects. Many times people are affected one, two or even three days later. Therefore, the researchers explored the risk of dying on the day of and up to three days after measuring fine PM and its components.

Study Results

- Elemental carbon, organic carbon, sulfate, metals
  - Found in fuel combustion and/or wood smoke
- All year: risk of cardiovascular mortality (1 – 2% per IQR)
  - All-cause mortality (0.5 – 1% per IQR)
- Cool Season: Higher risk of mortality (1 – 3% per IQR)



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The advantage of studying the components of fine PM is that you can investigate chemicals that come from particular sources separately. I want to highlight the results from components of fuel combustion and wood smoke. Elemental carbon, organic carbon, sulfate, and various metals are associated with gasoline and diesel vehicles. Elemental carbon, organic carbon and potassium are markers for wood burning.

When we examine the components of fuel combustion and wood smoke, they show about a 1-2% increase from heart disease and 0.5-1% increase risk of dying from all-causes.

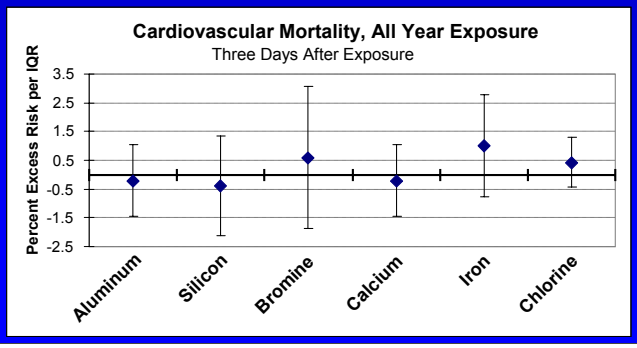
Interestingly, the effects are somewhat stronger in the cool months, October through March. Fuel and wood smoke components show an increased risk of dying of 1 to 3 percent from all-causes and heart disease.

There are a couple of reasons why the cool season results may show a greater risk of dying. The concentrations measured in the winter are higher overall. This may be due to a lower inversion layer in the cold months, which limits the amount of clean air that the pollutants can mix with. There are also different sources in the winter. For example, more residential wood burning occurs in the winter.

Another possibility is that more people die of influenza during the cool months. It is possible that some of the increased risk of dying during the cool season may reflect two unrelated events: an increase in PM concentration and an increase of dying from the flu.

Study Results (con't)

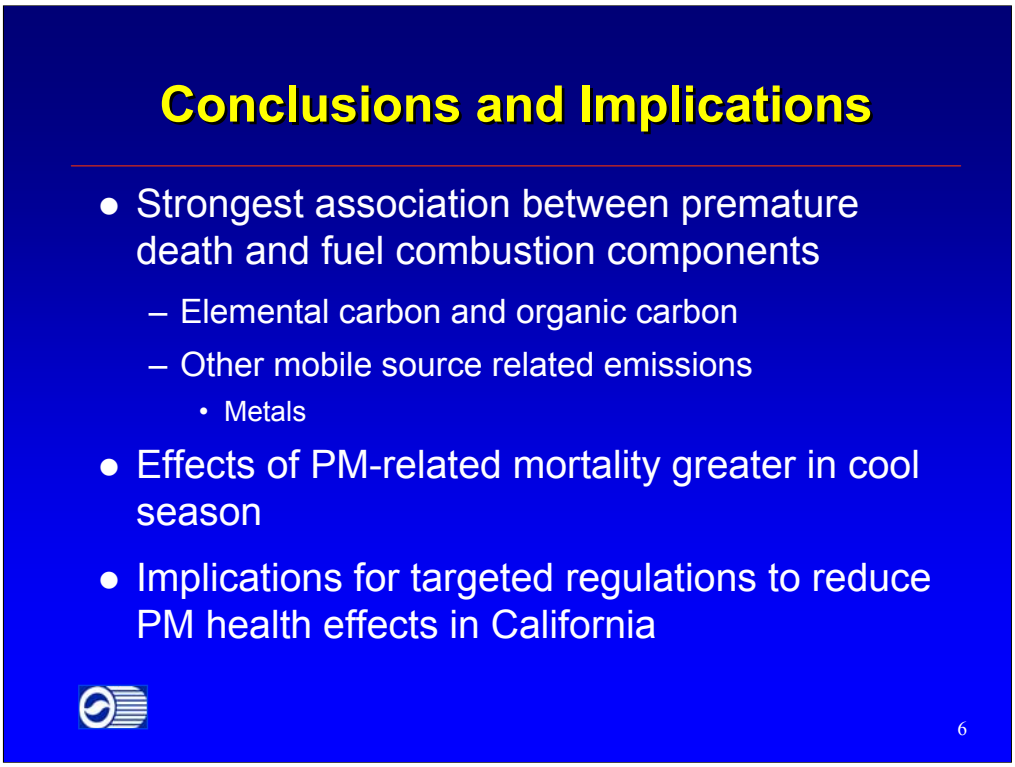
- Aluminum, silicon, iron, bromine, calcium, chlorine
  - Found in soil or sea spray
- All year: No increased risk of cardiovascular mortality
- Cool season: No statistically significant increased risk of cardiovascular mortality except iron.



In contrast to the fuel combustion and wood smoke, the components of natural particles, such as those from soil and sea spray, show no increased risk of premature death. Aluminum, silicon and iron are associated with soil. Bromine, calcium, and chlorine are found in sea spray.

The data from the full 4 years of the study for all the components of soil and sea spray indicate no increased risk of premature death from all-causes and cardiovascular causes.

In the cool season months, there is no statistically significant increased risk of dying for soil and sea spray components with the exception of iron.



The results from this study agree with findings from previous research showing a relationship between exposure to fine PM from combustion sources and premature deaths. Intervention studies have shown a decrease in premature death associated with the introduction of low sulfur fuel in Hong Kong and a coal ban in Dublin, and traffic studies have shown premature death and illness associated with living near a major roadway.

The investigators found the strongest and most consistent association with premature deaths and the fine PM components: elemental carbon, organic carbon, and mobile source related metals. The results also indicate stronger associations between mortality and fine PM components during the cool months.

These results provide further confirmation that reducing particulate pollution from motor vehicles and other PM combustion sources can lead to health benefits. It also begins to address the issue of relative toxicity of the components of PM, which could lead to regulations focused on the most toxic components of PM to better protect the public from the harmful effects of particles.

This concludes the health update and we would be happy to answer any questions.

Thank you very much.